Getting Ready for Energy-Efficient Networking
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A Network Inventory Data Model for Energy Efficiency Management
draft-cwbgp-green-inventory-energy-management-00

Abstract

As a complement to the YANG Network Topology Data Model for Energy Efficiency Management, which is used for monitoring the dynamic energy consumption of network devices, this document defines YANG Network Inventory Data Model for Energy Efficiency Management that can be used for maintaining capability related energy efficiency attributes. The model provides both network view and device view of energy efficiency related inventory information.

Discussion Venues

This note is to be removed before publishing as an RFC.

Discussion of this document takes place on the Network Inventory YANG Working Group mailing list (inventory-yang@ietf.org), which is archived at https://mailarchive.ietf.org/arch/browse/inventory-yang/.

Source for this draft and an issue tracker can be found at https://github.com/boucadair/draft-cwbgp-energy-saving-management.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on 3 September 2025.

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Table of Contents

1. Introduction

With the growth of networks and the increase of awareness about the environmental impact, it is important to ensure energy efficiency in the operation of network infrastructures. Operators are thus seeking for more information to reflect the power consumption of a network and the contribution of involved nodes.

However, there are no standard mechanisms to report either capability related energy efficiency attributes or dynamic power consumption of different networking equipment under different network configuration and conditions. [I-D.cwbgp-green-energy-saving-management] defines YANG module which is used for monitoring the dynamic energy consumption of network devices at both network and device levels (Section 3.5.1 of [I-D.ietf-netmod-rfc8407bis]).

As a complement to the YANG Network Topology Data Model for Energy Efficiency Management [I-D.cwbgp-green-energy-saving-management], this document defines YANG Network Inventory Data Model for Energy Efficiency Management that can be used for maintaining capability related energy efficiency attributes. The model provides both network view and device view of energy efficiency related inventory information.

The inventory model augments the "ietf-network-inventory" module [I-D.ietf-ivy-network-inventory-yang] with the following rationale:

* Parameters that reflect the saving modes and methods are considered as capabilities, and are thus maintained in the inventory.

The document leverages types defined in [RFC3418] and [RFC6933].

1.1. Notes to the RFC Editor

Note to the RFC Editor: This section is to be removed prior to publication.

This document contains placeholder values that need to be replaced

with finalized values at the time of publication. This note summarizes all the substitutions that are needed.

Please apply the following replacements:

* XXXX --> the RFC number assigned to this I-D

* 2024-01-23 --> the actual date of the publication of this document

2. Conventions and Definitions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

The meanings of the symbols in the YANG tree diagrams are defined in [RFC8340].

The document uses the terms defined in [I-D.bclp-green-terminology] and [I-D.ietf-ivy-network-inventory-yang].

3. YANG Prefixes

Names of data nodes and other data model objects are prefixed using the standard prefix associated with the corresponding YANG imported modules, as shown in {{pref}}.

Prefix	YANG Module	Reference
ianahw	iana-hardware	[IANA_YANG]
ni	ietf-network-inventory	[I-D.ietf-ivy-network-inventory-yang]
yang	ietf-yang-types	[RFC6991]

Table 1: Prefixes and Corresponding YANG modules

4. Energy Saving Management Data Model Overview

4.1. Overview

As described in [I-D.ietf-ivy-network-inventory-yang], the Network Inventory YANG data model is used to maintain the base network inventory information. This document defines the YANG module "ietf-ni-energy-saving", which augments network element of the network Inventory base model with energy saving modes, associated energy saving methods and augments the component of the network inventory base model with capability related power attributes.

The data model defines energy saving modes representing some energy consumption levels, which are basic, standard, or deep. For each consumption level, there is a combination of methods to reach the energy saving target level.

At the component level, the data model includes a set of threshold related power parameters such as rated power, expected volts.

4.2. ESM Inventory Model

The structure of the ESM Network Inventory Model is depicted in Figure 1.

```
module: ietf-ni-energy-saving
  grouping network-element-ref:
    +-- ne-ref?   leafref
  grouping component-ref:
    +-- node-ref?   leafref
    +-- ne-ref?     leafref

  augment /ni:network-inventory/ni:network-elements
          /ni:network-element:
    +--ro energy-management {esm-common:energy-saving}?
       +--ro energy-monitoring-capability?   boolean
       +--ro energy-saving-modes
          +--ro energy-saving-mode* [mode]
             +--ro mode                    identityref
             +--ro energy-saving-method*   identityref
  augment /ni:network-inventory/ni:network-elements
          /ni:network-element/ni:components/ni:component:
    +--ro power-parameters {esm-common:energy-saving}?
       +--ro temperature-upper-bound?    int32
       +--ro temperature-middle-bound?   int32
       +--ro temperature-lower-bound?    int32
       +--ro rated-power?                yang:gauge64
       +--ro expected-volts?             int32
       +--ro low-volts-bound?            int32
       +--ro low-volts-fatal?            int32
       +--ro high-volts-bound?           int32
       +--ro high-volts-fatal?           int32
```

Figure 1: ESM Inventory Model Tree Structure

5. Network Inventory Energy Saving YANG Module

The module imports "ietf-network-inventory" [I-D.ietf-ivy-network-inventory-yang] and "ietf-energy-saving-common".

<CODE BEGINS> file "ietf-ni-energy-saving@2024-01-23.yang"

```
module ietf-ni-energy-saving {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-ni-energy-saving";
  prefix esm-ni;

  import ietf-energy-efficiency-common {
    prefix esm-common;
    reference
      "RFC XXXX: YANG Data Models for Energy Saving Management";
  }
  import ietf-network-inventory {
    prefix ni;
    reference
      "RFC IIII: A YANG Data Model for Network Inventory";
  }

  organization
    "IETF xxx Working Group.";
  contact
    "WG Web:   <https://datatracker.ietf.org/wg/xxx/>;
     WG List:  <mailto:xxxx@ietf.org>

     Author:   Gen Chen
               <mailto:chengen@huawei.com>
     Editor:   Qin Wu
               <mailto:bill.wu@huawei.com>
     Editor:   XXX XXXX
               <mailto:xxx.xxx@orange.com>
     Author:   Carlos Pignataro
```

```
             <mailto:cpignata@gmail.com>";
  description
    "This module contains a collection of YANG definitions for power
     and energy management of devices. It also augments both the
     network topology and inventory models.

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     identified as authors of the code.  All rights reserved.

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     to the license terms contained in, the Revised BSD License
     set forth in Section 4.c of the IETF Trust's Legal Provisions
     Relating to IETF Documents
     (https://trustee.ietf.org/license-info).

     This version of this YANG module is part of RFC XXXX; see
     the RFC itself for full legal notices.";

  revision 2024-01-23 {
    description
      "Initial revision.";
    reference
      "RFC XXXX: YANG Data Models for Energy Saving Management";
  }

  grouping network-element-ref {
    description
      "Contains the information necessary to reference a network
       element.";
    leaf ne-ref {
      type leafref {
        path "/ni:network-inventory/ni:network-elements"
           + "/ni:network-element/ni:ne-id";
        require-instance false;
      }
      description
        "Used to reference a network element.";
    }
  }

  grouping component-ref {
    description
      "Contains the information necessary to reference a component.";
    leaf node-ref {
      type leafref {
        path "/ni:network-inventory/ni:network-elements"
           + "/ni:network-element[ni:ne-id="
           + "current()/../ne-ref]/ni:components/ni:component"
           + "/ni:component-id";
        require-instance false;
      }
      description
        "Used to reference a component.";
    }
    uses network-element-ref;
  }

  augment "/ni:network-inventory/ni:network-elements"
        + "/ni:network-element" {
    if-feature "esm-common:energy-saving";
    description
      "Energy management static data for network element.";
    container energy-management {
      config false;
      description
```

```
          "Statistics of the energy management.";
        leaf energy-monitoring-capability {
          type boolean;
          description
            "Indicates whether monitoring can be performed.";
        }
        container energy-saving-modes {
          description
            "List of supported energy saving modes.";
          uses esm-common:energy-saving-modes;
        }
      }
    }

    augment "/ni:network-inventory/ni:network-elements"
          + "/ni:network-element/ni:components/ni:component" {
      if-feature "esm-common:energy-saving";
      description
        "Energy management static data for component.";
      container power-parameters {
        config false;
        description
          "Power parameter monitoring.";
        uses esm-common:power-parameters;
      }
    }
  }
  <CODE ENDS>
```

6. Security Considerations

This section is modeled after the template described in Section 3.7 of [I-D.ietf-netmod-rfc8407bis].

The "ietf-ni-energy-saving" YANG module defines a data model that is designed to be accessed via YANG-based management protocols, such as NETCONF [RFC6241] and RESTCONF [RFC8040]. These protocols have to use a secure transport layer (e.g., SSH [RFC4252], TLS [RFC8446], and QUIC [RFC9000]) and have to use mutual authentication.

The Network Configuration Access Control Model (NACM) [RFC8341] provides the means to restrict access for particular NETCONF or RESTCONF users to a preconfigured subset of all available NETCONF or RESTCONF protocol operations and content.

Some of the readable data nodes in this YANG module may be considered sensitive or vulnerable in some network environments. It is thus important to control read access (e.g., via get, get-config, or notification) to these data nodes. Specifically, the following subtrees and data nodes have particular sensitivities/ vulnerabilities:

'TBC': ....

7. IANA Considerations

7.1. The "IETF XML" Registry

This document requests IANA to register the following URIs in the "ns" sub-registry within the "IETF XML Registry" [RFC3688]:

```
   URI: urn:ietf:params:xml:ns:yang:ietf-ni-energy-saving
   Registrant Contact: The IESG.
   XML: N/A, the requested URIs are XML namespaces.
```

7.2. The "YANG Module Names" Registry

This document requests IANA to register the following YANG modules in the "YANG Module Names" registry [RFC6020] within the "YANG Parameters" registry group.

```
   name: ietf-ni-energy-saving
   prefix: esm-ni
   namespace: urn:ietf:params:xml:ns:yang:ietf-ni-energy-saving
   Maintained by IANA? N
   Reference: RFC XXXX
```

8. References

8.1. Normative References

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8.2. Informative References

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Acknowledgments

This work has benefited from the discussions that occurred during the Sustainable Networking Side Meeting in IETF#117 and the "e-impact" IAB workshop. In particular, [I-D.cx-opsawg-green-metrics] assess several sustainability-related attributes such as power consumption, energy efficiency, and carbon footprint associated with a network, its equipment, and the services that are provided over it and suggest a set of metrics that provide network observability and can be used to optimize a network's "greenness". [I-D.manral-bmwg-power-usage] and [I-D.cprjgf-bmwg-powerbench] provide suggestions for measuring power usage of live networks under different traffic loads and various switch router configuration settings.

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